SYSTEM AND METHOD FOR PROVIDING TACTILITY FOR AN LCD TOUCHSCREEN

RELATED APPLICATION

[0001] This application claims priority on U.S. provisional application Serial No. 60/315,556 entitled SYSTEM AND METHOD FOR PROVIDING TACTILITY FOR AN LCD TOUCHSCREEN filed Aug. 28, 2001. By this reference, the full disclosure, including the drawings, of U.S. provisional application Serial No. 60/315,556 is incorporated herein.

FIELD OF THE INVENTION

[0002] The present invention generally relates to interfaces between users and computing devices. More particularly, the present invention relates to liquid crystal display interfaces.

BACKGROUND OF THE INVENTION

[0003] Buttons, track balls and thumbwheels are well known user interfaces that permit users to operate electronic devices. In devices where space is limited, such as in mobile communication devices and personal digital assistants (PDA), touchscreens are preferred as the user interface since their virtual "buttons" do not require the assemblies and space required for implementing mechanical user interfaces such as buttons, track balls and thumbwheels.

[0004] Although touchscreens have been commonly used for electronic devices, they do not offer the tactility of the aforementioned mechanical user interfaces. For example, the user can physically feel that an input has been made because the buttons or wheels move. Touchscreens on the other hand do not have perceptible movement when the user touches it with a finger or stylus. Therefore, the user can only visually confirm that an input has been made. Visual-only feedback substantially increases the possibility of input error, which decreases the efficiency of use. Audio notification is commonly used in electronic devices, but does not work well in noisy environments and can disturb the user or other people who are close by.

[0005] It is, therefore, desirable to provide a means for reliably alerting the user that a touchscreen input has been made.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to obviate or mitigate at least one disadvantage of previous touchscreen and LCD user interface feedback systems. In particular, it is an object of the present invention to provide a touchscreen and LCD user interface that reliably validates an input made by the user through the touchscreen.

[0007] In a first aspect, the present invention provides a force feedback system having a touchscreen controller for providing touchscreen data in response to a touchscreen contact, and a liquid crystal display for displaying graphics. The force feedback system includes a controller for determining display data and actuator control signals in response to the touchscreen data, where the liquid crystal display displaying the graphics corresponding to the display data, and an actuator for pulsing in response to the actuator control signals.

[0008] In an embodiment of the present aspect, the controller, and the touchscreen controller are integrated within a single application specific integrated circuit.

[0009] In further embodiments of the present aspect, the actuator includes multiple actuating devices, and the actuator can include a vibrating motor or a solenoid.

[0010] In further aspect, the present invention provides a method for tactile notification in a system having a touchscreen and liquid crystal display user interface. The method includes the steps of prompting for an input through the liquid crystal display, providing actuator control signals when the touchscreen is touched, and activating an actuator for providing force feedback in response to the actuator control signals.

[0011] In an embodiment of the present aspect, the step of prompting includes driving the liquid crystal display with graphical information for requesting the input.

[0012] In another embodiment of the present aspect, the step of providing actuator control signals includes receiving electrical signals from the touchscreen when the touchscreen is touched, decoding the electrical signals into touchscreen data, and processing the touchscreen data to generate the actuator control signals.

[0013] In yet another embodiment of the present aspect, the step of providing actuator control signals includes providing display data when the touchscreen is touched, and the step of providing display data includes receiving electrical signals from the touchscreen when the touchscreen is touched, decoding the electrical signals into touchscreen data, and processing the touchscreen data to generate display data.

[0014] In yet a further embodiment of the present aspect, the step of activating the actuator includes changing the graphics of the liquid crystal display in response to the display data, and the step of changing includes driving the liquid crystal display with graphical information requesting another input.

[0015] Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

[0017] **FIG. 1** is a block diagram of a force feedback system for a touchscreen and LCD user interface according to an embodiment of the present invention; and

[0018] **FIG. 2** is a flow diagram describing a method for providing tactile feedback in the system of **FIG. 1**.

DETAILED DESCRIPTION

[0019] Generally, the present invention provides a method and system for providing force feedback in response to touchscreen inputs by a user. A touchscreen overlayed upon a liquid crystal display (LCD) receives user input and provides a corresponding signal to a controller or central